Age-Length Key

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Age-length keys will be produced from the measured TL and the age-at-capture of each Largemouth Bass. All samples will be divided into 25 mm bins? size bins (denoted L_i) and grouped by age (A_j). The probability that a fish is a particular age given its size ($p_{j|i}$) will be calculated by dividing the number of fish (n_{ji}) in the i^th length interval of the j^th age by the total number of fish in that size interval. The calculation for $p_{j|i}$ will be performed in R using the FSA, magrittr, and dplyr packages according to the methods described by Derek Ogle (2016a) (Bache and Wickham 2016, Ogle 2016b, Wickham and Francois 2016).

```
library(FSA)
```

```
## ## FSA v0.8.16. See citation('FSA') if used in publication.
## ## Run fishR() for related website and fishR('IFAR') for related book.
```

```
library(magrittr)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(nnet)
```

```
LMB <- read.csv("Data/Clean-Data/2016_largemouth-bass_clean.csv") %>%
  select(FID,Site,AgeCap,LenCap,WTg,SEXCON,Sex)

LMB$FID <- factor(LMB$FID)
LMB$Site <- factor(LMB$Site)
LMB$SEXCON <- factor(LMB$SEXCON)
LMB$Sex <- factor(LMB$Sex)

length(LMB$FID)
```

```
## [1] 131
```

```
LMB[LMB$FID==55,]
```

```
## [1] FID    Site   AgeCap LenCap WTg    SEXCON Sex
## <0 rows> (or 0-length row.names)
```

```
#LMB <- LMB[-55,] ## Remove FID 55
length(LMB$FID)
```

```
## [1] 131
```

```r
LMB <- filterD(LMB,!is.na(FID))

str(LMB)
```

```
## 'data.frame':    131 obs. of  7 variables:
##  $ FID   : Factor w/ 131 levels "1","2","3","4",..: 1 2 3 4 5 6 7 8 9 10 ...
##  $ Site  : Factor w/ 11 levels "2","4","6","8",..: 6 6 6 7 10 10 10 10 10 10 ...
##  $ AgeCap: int  4 4 4 6 4 NA 1 2 4 8 ...
##  $ LenCap: int  347 292 348 374 375 355 195 289 388 423 ...
##  $ WTg   : int  658 415 557 669 716 719 118 479 986 1258 ...
##  $ SEXCON: Factor w/ 5 levels "0","1","3","6",..: 5 3 3 5 3 5 5 3 3 5 ...
##  $ Sex   : Factor w/ 3 levels "0","1","2": 3 2 2 3 2 3 3 2 2 3 ...
```

```r
headtail(LMB)
```

```
##     FID  Site AgeCap LenCap WTg SEXCON Sex
## 1     1    11      4    347 658      8   2
## 2     2    11      4    292 415      3   1
## 3     3    11      4    348 557      3   1
## 129 130    15      2    266 305      8   2
## 130 131    15      2    261 282      3   1
## 131 132 15972      7    395 971      3   1
```

```r
LMB %<>% mutate(lencat25=lencat(LenCap,w=25))
headtail(LMB)
```

```
##     FID  Site AgeCap LenCap WTg SEXCON Sex lencat25
## 1     1    11      4    347 658      8   2      325
## 2     2    11      4    292 415      3   1      275
## 3     3    11      4    348 557      3   1      325
## 129 130    15      2    266 305      8   2      250
## 130 131    15      2    261 282      3   1      250
## 131 132 15972      7    395 971      3   1      375
```

```r
is.na(LMB$AgeCap)
```

```
##   [1] FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE
##  [12] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [23] FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE
##  [34] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [45] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [56] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [67] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [78]  TRUE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [89] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [100] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [111] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [122] FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```r
LMB.unaged <- filter(LMB, is.na(AgeCap))
headtail(LMB.unaged)
```

```
##    FID Site AgeCap LenCap WTg SEXCON Sex lencat25
## 1    6   18     NA    355 719      8   2      350
## 2   28   18     NA    193 125      6   2      175
## 3   79    8     NA    169  71      6   2      150
## 31  79    8     NA    169  71      6   2      150
## 4   81    8     NA    166  74      1   1      150
## 5  124   15     NA    202 136      1   1      200
```

```r
all(is.na(LMB.unaged$AgeCap)) # Better be True
```

```
## [1] TRUE
```

```r
LMB.aged <- filter(LMB,!is.na(AgeCap))
headtail(LMB.aged)
```

```
##     FID  Site AgeCap LenCap WTg SEXCON Sex lencat25
## 1     1    11      4    347 658      8   2      325
## 2     2    11      4    292 415      3   1      275
## 3     3    11      4    348 557      3   1      325
## 124 130    15      2    266 305      8   2      250
## 125 131    15      2    261 282      3   1      250
## 126 132 15972      7    395 971      3   1      375
```

```r
any(is.na(LMB.aged$AgeCap)) # Better be False
```

```
## [1] FALSE
```

```r
(alk.freq <- xtabs(~lencat25+AgeCap,data = LMB.aged))
```

```
##          AgeCap
## lencat25  1  2  3  4  5  6  7  8
##      100  2  0  0  0  0  0  0  0
##      125  6  0  0  0  0  0  0  0
##      150  6  0  0  0  0  0  0  0
##      175  7  0  0  0  0  0  0  0
##      200  5  2  0  0  0  0  0  0
##      225  4  5  0  0  0  0  0  0
##      250  0 14  0  0  0  0  0  0
##      275  0 19  1  1  0  0  0  0
##      300  0  8  6  0  0  0  0  0
##      325  0  0  1  7  2  0  0  0
##      350  0  0  0 11  4  1  1  0
##      375  0  0  0  4  3  0  2  0
##      400  0  0  0  1  1  0  0  1
##      425  0  0  0  0  0  1  0  0
```

```r
rowSums(alk.freq)
```

```
## 100 125 150 175 200 225 250 275 300 325 350 375 400 425
##   2   6   6   7   7   9  14  21  14  10  17   9   3   1
```

```r
alk <- prop.table(alk.freq,margin = 1)
round(alk,3)
```

```
##          AgeCap
## lencat25     1     2     3     4     5     6     7     8
##      100 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
##      125 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
##      150 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
##      175 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
##      200 0.714 0.286 0.000 0.000 0.000 0.000 0.000 0.000
##      225 0.444 0.556 0.000 0.000 0.000 0.000 0.000 0.000
##      250 0.000 1.000 0.000 0.000 0.000 0.000 0.000 0.000
##      275 0.000 0.905 0.048 0.048 0.000 0.000 0.000 0.000
##      300 0.000 0.571 0.429 0.000 0.000 0.000 0.000 0.000
##      325 0.000 0.000 0.100 0.700 0.200 0.000 0.000 0.000
##      350 0.000 0.000 0.000 0.647 0.235 0.059 0.059 0.000
##      375 0.000 0.000 0.000 0.444 0.333 0.000 0.222 0.000
##      400 0.000 0.000 0.000 0.333 0.333 0.000 0.000 0.333
##      425 0.000 0.000 0.000 0.000 0.000 1.000 0.000 0.000
```

```
### Some weirdness here I have a 450 mm 2 year old (FID 55 removed) and 425 mm 6 yr old while my 8 year
```

```
LMB.mlr <- multinom(AgeCap~lencat25,data=LMB.aged,maxit=500)
```

```
## # weights:  24 (14 variable)
## initial  value 262.009634
## iter  10 value 164.396061
## iter  20 value 86.952303
## iter  30 value 78.341952
## iter  40 value 77.812635
## iter  50 value 76.672948
## iter  60 value 76.393223
## iter  70 value 76.390701
## iter  70 value 76.390700
## final  value 76.390585
## converged
```

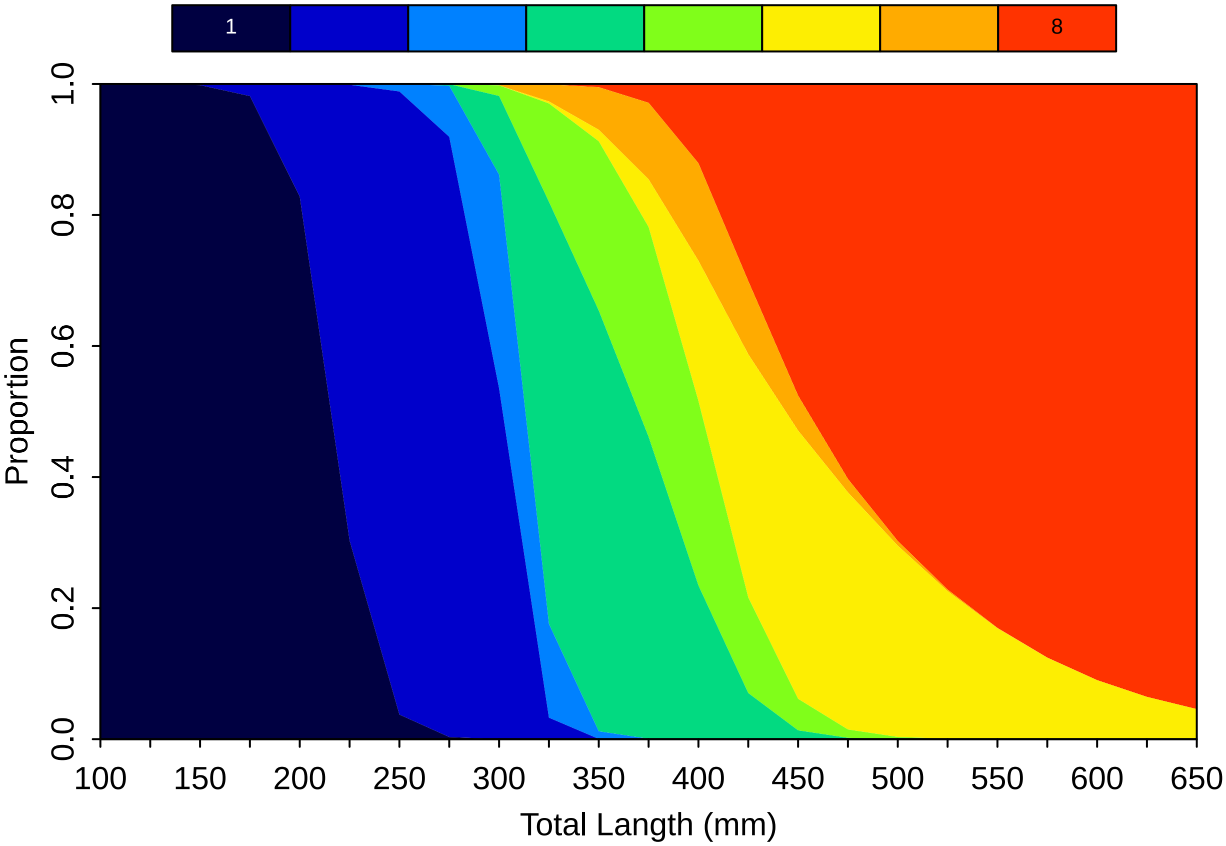
```
lens <- seq(100,650,25)
alk.sm <- predict(LMB.mlr,data.frame(lencat25=lens),type = "probs")
row.names(alk.sm) <- lens # for clarity
round(alk.sm,3) #for display purposes
```

```
##         1     2     3     4     5     6     7     8
## 100 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
## 125 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
## 150 0.998 0.002 0.000 0.000 0.000 0.000 0.000 0.000
## 175 0.982 0.018 0.000 0.000 0.000 0.000 0.000 0.000
## 200 0.828 0.172 0.000 0.000 0.000 0.000 0.000 0.000
## 225 0.303 0.696 0.001 0.000 0.000 0.000 0.000 0.000
## 250 0.037 0.951 0.011 0.000 0.000 0.000 0.000 0.000
## 275 0.003 0.916 0.078 0.002 0.000 0.000 0.000 0.000
## 300 0.000 0.535 0.326 0.120 0.016 0.000 0.002 0.000
## 325 0.000 0.033 0.143 0.644 0.150 0.003 0.026 0.001
## 350 0.000 0.000 0.012 0.642 0.258 0.018 0.065 0.005
## 375 0.000 0.000 0.001 0.461 0.320 0.073 0.117 0.029
## 400 0.000 0.000 0.000 0.235 0.282 0.214 0.149 0.121
## 425 0.000 0.000 0.000 0.070 0.146 0.371 0.112 0.301
## 450 0.000 0.000 0.000 0.013 0.048 0.410 0.053 0.476
## 475 0.000 0.000 0.000 0.002 0.013 0.362 0.020 0.603
## 500 0.000 0.000 0.000 0.000 0.003 0.292 0.007 0.698
## 525 0.000 0.000 0.000 0.000 0.001 0.225 0.002 0.772
## 550 0.000 0.000 0.000 0.000 0.000 0.169 0.001 0.830
## 575 0.000 0.000 0.000 0.000 0.000 0.124 0.000 0.875
## 600 0.000 0.000 0.000 0.000 0.000 0.090 0.000 0.910
## 625 0.000 0.000 0.000 0.000 0.000 0.065 0.000 0.935
## 650 0.000 0.000 0.000 0.000 0.000 0.046 0.000 0.954
```

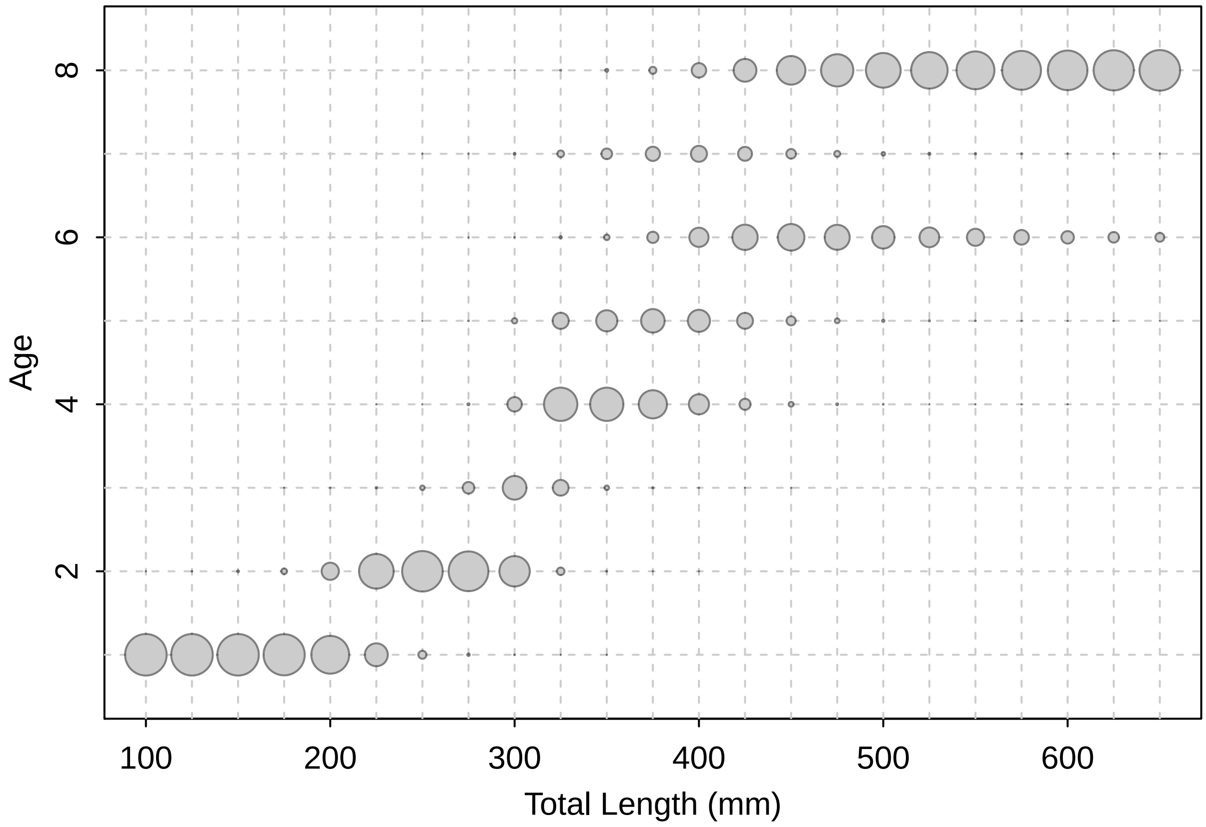
```
### Much better but still double check the ages from before!!!
```

Smoothed Age-Length Key Model

```
### Smoothed ALK Model
alkPlot(alk.sm,type = "area",showLegend = TRUE,leg.cex = 0.7,xlab = "Total Langth (mm)")
```

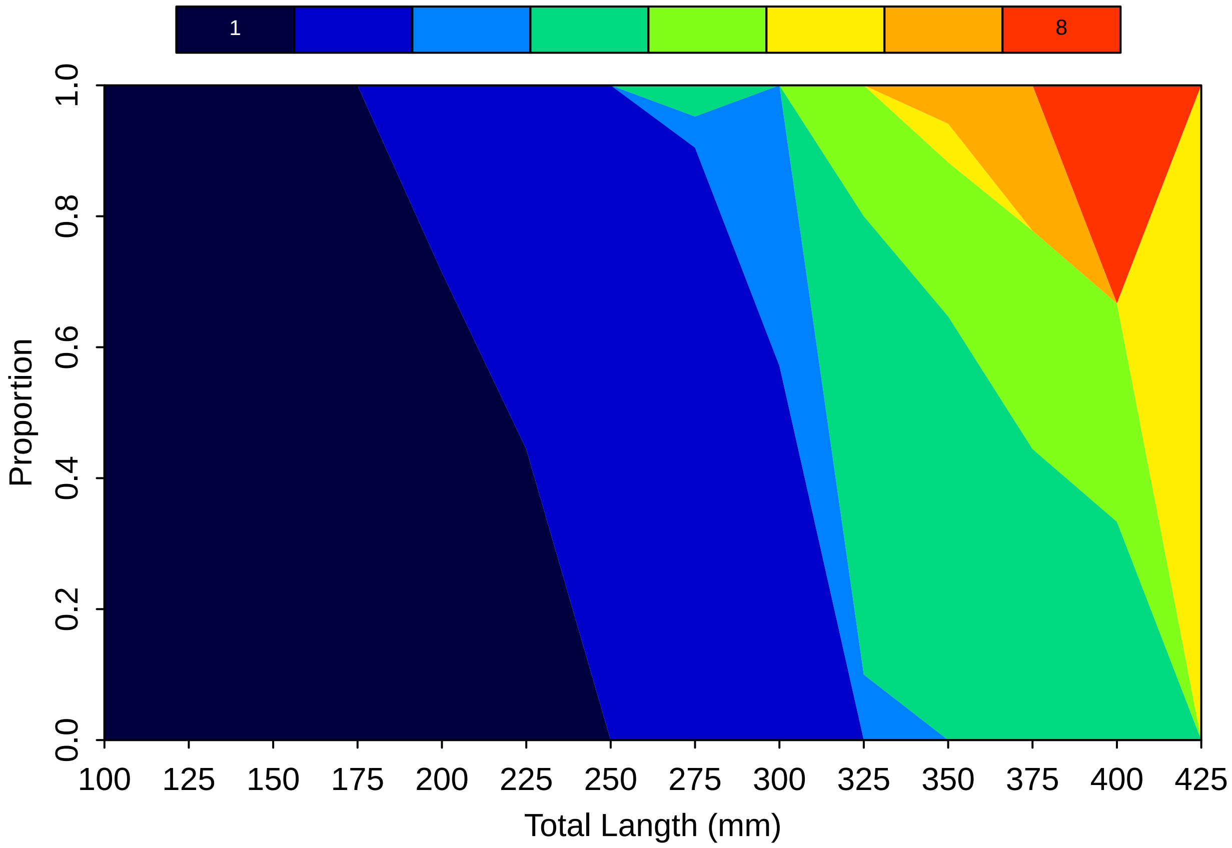


```
alkPlot(alk.sm,type = "bubble", xlab = "Total Length (mm)")
```

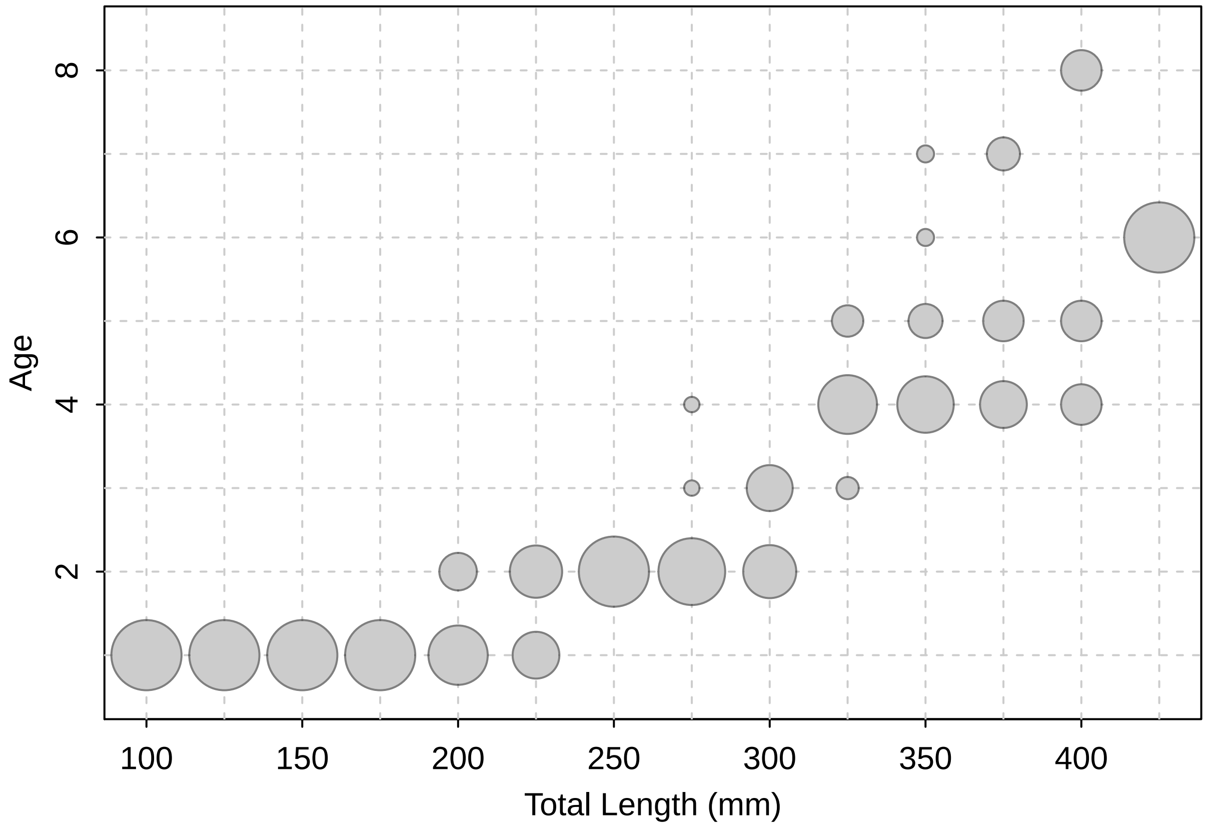


Age-Length Key

```
alkPlot(alk,type = "area",showLegend = TRUE,leg.cex = 0.7,xlab = "Total Langth (mm)")
```



```
alkPlot(alk,type = "bubble", xlab = "Total Length (mm)")
```



```
### Doesn't Look Good!!!
```